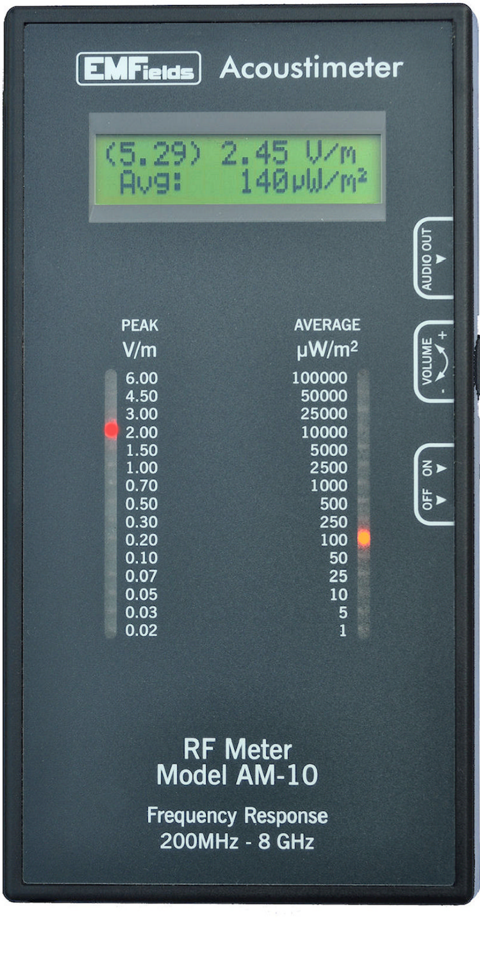

Acoustimeter User Manual

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Introduction

The Acoustimeter has been designed to enable you to make a quick and informed judgement regarding the level and nature of microwave signals in your environment. It is a broadband instrument that accurately measures the totality of the radiation in the range 200 MHz to over 8000 MHz (8 GHz), which covers the frequencies used by most modern communication systems encountered in our everyday environment. The Acoustimeter was designed using the experience gained from many years of practical RF and microwave measurements using a wide variety of professional instruments.

Readings are shown on both an LCD display and two series of graduated LED lights. The LEDs update rapidly, and allow you to quickly gauge the levels in an area and find any hot-spots. The Acoustimeter also has a loudspeaker (and audio output socket for headphones or an audio recorder), allowing you to determine, with a small amount of practice, what type of device is creating the levels that are present. Sound samples are available on http://www.emfields.org/detectors/acoustimeter.asp to help you identify different signals.

Safety instructions

Please read through these instructions carefully before operating the instrument. It contains important information regarding usage, safety and maintenance.

The instrument is not waterproof and should not come into direct contact with water, nor should it be used outdoors in the rain. If it is raining and you want to take measurements outside, please cover the instrument in a plastic bag that does not have holes in it. Clean the case using a damp cloth, and do not use detergents.

This instrument is sensitive to heat and impact. Exposing the instrument to high temperatures or dropping the instrument may cause it to stop functioning properly. It may not display properly below freezing (0°C). This instrument is not intended to be serviced by the user and it needs no special maintenance from the user. Unscrewing the case will void the guarantee.

Specifications

Typical overall frequency response using the internal antenna:
200 MHz – 8000 MHz ± 3dB; 150-200 MHz and 8000-10000 MHz ± 6dB

Measurement sensitivity: 0.02 to 6.00 volts per metre [V/m]
1 to 100 000 microwatts per square metre [$\mu W/m^2$]

The detector can respond to levels below 0.02 V/m - audio from signal demodulation may be heard at RF levels below 0.02 V/m

LED Scale Points: (peak LEDs updated approximately every 0.1 seconds)

Peak: 0.02, 0.03, 0.05, 0.07, 0.1, 0.2, 0.3, 0.5, 0.7, 1, 1.5, 2, 3, 4.5, 6 V/m

Average: (calculated as the average 1024 samples measured every c. 0.35 seconds)
1, 5, 10, 25, 50, 100, 250, 500, 1 000, 2 500, 5 000, 10 000, 25 000, 50 000, 100 000 $\mu W/m^2$

Power Draw: 105 mA at 3 volts (2 x AA Alkaline or Rechargeable cells @ 1.2 - 1.5V)

Battery Life: Up to 20 hours. 'Low battery' detection is indicated.

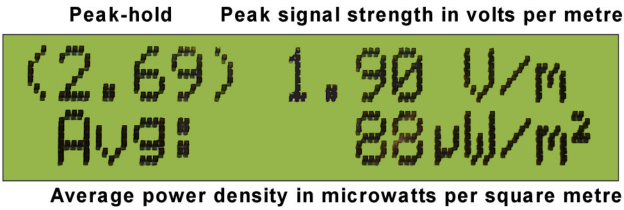
Typically 15 hours on two new 1500 mAhr AA alkaline cells and

Typically 25 hours on two charged 2700 mAhr NIMH rechargeable cells

Size: 190mm x 102mm x 33mm (LxWxD)

Weight: 280g, excluding batteries

Instrument guide



Key

1. Display
2. Peak signal LEDs
3. Average power LEDs
4. Audio, mono 2.5mm
5. Volume control
6. On - Off switch
7. Internal antenna
8. Loudspeaker
9. Battery compartment

Operation

Ensure that you have correctly inserted appropriate batteries (2 x AA cells). Move the power switch into the “On” position. The LCD display should briefly display “Acoustimeter, © EMFields 2009”, changing to readings after a short time.

Hold the bottom of the instrument in one hand at least 30cm from your body as close proximity to your body will affect the readings. Keep your hands away from the top of the instrument as this contains the antenna which is located inside the case at the rear towards the top. The Acoustimeter can be placed upon a stable surface, but movements nearby can still affect the RF/microwave levels.

Adjust the volume to an appropriate level (usually somewhere about mid-volume is best; only use maximum when monitoring weak signals).

The instrument will display the peak signal strength and the average power on both the LEDs and the LCD. Slowly turn the instrument around in all directions. Stop moving the instrument and hold it still to take a reading.

Bear in mind that even moving the meter small distances can result in detecting very different levels of microwave energy. Microwaves are reflected off the ground and other surfaces so it is important to check all angles. The highest readings will often be found when holding the instrument facing you at an angle between horizontal and vertical.

We recommend taking the highest reading found in any one spot, as this is when the antenna is most closely aligned with the directionality of the signal. The “Peak-hold” function will display the highest peak reading measured until the instrument is turned off and on again.

If there is hardly any noise with the volume turned up then the instrument is not detecting any amplitude modulated (i.e. “pulsing”) signals. Other sounds represent the amplitude modulation and digital pulsing of RF signals detected by the instrument. It is sometimes possible to hear voices and music when very close to powerful medium and short-wave AM transmitters, which are outside of the normal RF frequency detection range of the meter. When no LEDs are illuminated any quiet ticking sounds heard should be ignored.

Why are there two different readings?

The Acoustimeter is unique in the way it displays information about its measurements. There are two different displayed results showing both Peak and Average measurements. At first, this may seem confusing. We believe that it is important to know both when assessing your exposure to modern telecommunication signals.

Digital and Analogue: *What is the difference?*

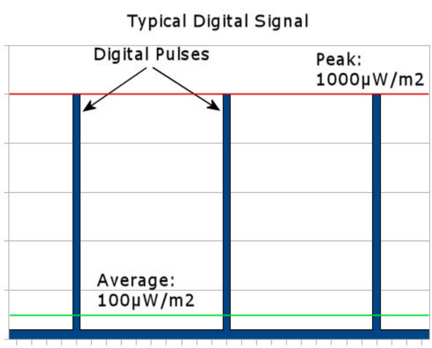
Many modern wireless devices use a **digital** system of communicating. This includes Mobile Phones (GSM & 3G/UMTS), WiFi, Cordless phones (DECT), Digital TV & Digital (DAB) Radio. Many modern digital systems (such as GSM, DECT and WiFi) turn the signal on and off at high speeds to represent data, often with long gaps between data bursts. This produces a non-continuous signal, which we describe as “pulsing”. It is these amplitude changes that the Acoustimeter allows you to hear.

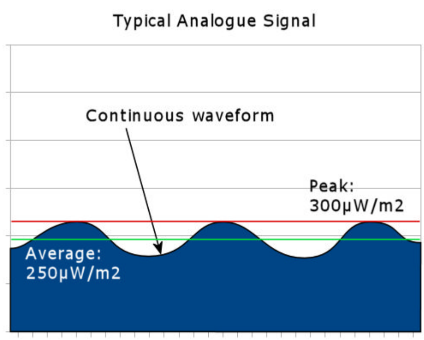
An analogue signal is a system of communication that is not digital. The old TV system, most radios, walkie-talkies and hearing aids are examples of analogue signals. They use a continuous carrier, and instead of turning “on and off” to represent data, will vary the frequency (FM) or strength (AM). Analogue TV & VHF FM Radio stations are being phased out over time.

Typical differences between Peak and Average

With an analogue system, the peak and average levels should be similar, as the signal is continuously on while it is being used.

However, because most digital systems spend a large proportion of their time not transmitting, the average level does not represent the actual waveform even though it is technically accurate as shown in the diagrams below.





Why does this matter?

Since wireless communications were first developed on a large scale, the scientific community held the opinion that *"if it does not heat you it will not hurt you"*, as 30 years ago these were the only effects that were acknowledged... The obvious thing to measure was the average heating effect. The metric typically used now for measuring the averaged power of microwave frequency EMFs is microwatts of power arriving per square metre ($\mu W/m^2$), and we have used this for the Acoustimeter's average power measurement.

There have now been hundreds of studies finding non-thermal effects from modern wireless communication signals, which means that the measurement system needs to be re-addressed to suit much lower signal levels and very different characteristics. We believe that peak signal strength is the most appropriate way to measure complex digitally modulated, often non-continuous, signals in a meaningful manner. Signal strength is measured in volts per metre (V/m). Many electrosensitive individuals report adverse health effects in areas that have quite high peak levels but have average field strengths below the more precautionary average power guidelines.

You can mathematically convert between V/m and $\mu W/m^2$, but this is only accurate if you have a continuous waveform (CW) carrier signal. See Appendix C for further details.

What do the different LED colours mean?

Our peak signal strength scale is based on personal experience of what electrosensitive individuals have reported as adversely affecting their health.

Below 0.05 volts per metre (V/m), few people report ill-effects, so these are green. Between 0.05 and 0.5 V/m, some individuals report ill-effects, so these are yellow. Above 0.5 V/m, nearly all electrosensitive individuals report experiencing some adverse health effects, so these are red.

The average power density scale LEDs are all orange in colour.

The LED points on each of the scales approximately match for continuous wave (CW) signals. The more pulsatile the signal is the higher the peak scale will read in comparison to the average power scale.

The LED scales are shown on the next page.

Peak - V/m

6.00	
4.50	
3.00	
2.00	
1.50	
1.00	
0.70	
0.50	«— Most ES individuals do experience adverse health effects above this level
0.30	
0.20	
0.10	
0.07	
0.05	«— Most ES individuals don't experience significant adverse health effects below this level
0.03	
0.02	

Average - μW/m²

100000	
50000	
25000	
10000	«— Typical max in public areas near base station masts (can be higher)
5000	
2500	
1000	«— BioIniative, 2007; Salzburg, 1998
500	
250	
100	
50	
25	
10	«— Salzburg - 2002, outside houses
5	
1	«— Salzburg - 2002, inside houses

Troubleshooting

Problem	Possible Solutions
The instrument is not showing any reading The Acoustimeter doesn't seem to be working	Check that the power switch is in the "on" position Check that the batteries are correctly inserted into the instrument. The batteries may be flat. Try changing them. *If the LCD is displaying a reading, then it is turned on and working.*
The instrument is not picking up signals very well	Make sure your fingers are not covering the area where the internal aerial is located (see diagram). Rotate the instrument in all directions. The aerial will pick up signals best when it is most aligned with them. This is usually between horizontal and vertical, but can be in any position. *When aligned with the signals, the instrument will pick up and indicate levels of 0.02 V/m or above.*
The instrument is giving varying readings	Make sure your fingers are clear of the aerial. Digital signals pulse, which means that peak signals are not consistent. The instrument is very sensitive and picks up these variations. Make sure you hold the instrument still, or place it on something to hold it steady. Field levels can vary substantially even over small distances. Regular high "blips" every few seconds may be due to a rotating radar transmitter or a WiFi signal
The instrument is giving readings that surprise me. Are they correct?	Our extensive tests have shown that the Acoustimeter readings give a good indication of the microwave levels being measured. The Specifications are given on page 3. Receiving and measuring pulsing RF signals over a wide frequency range is extremely difficult to do. Even professional instruments costing many thousands of pounds have quite large error margins. How you should add all the various frequencies and waveforms is a large debate on its own. Different meters may well give different readings depending on what is being measured.

Problem	Possible Solutions
It still makes a noise when inside a headnet/behind my screening	The audio produced by the Acoustimeter is logarithmic in volume, so even quiet signals can seem quite loud. Check the figures that the Acoustimeter is displaying for an accurate measure of how effective your screening is. Close to transmitting sources it is likely that you will still hear something. You may have a gap in your screening. Even small gaps (including above and below you) will let in microwave signals. Your screening material may have deteriorated over time.
The levels are very low, but I can just hear a slow, regular, ticking (a bit like a very faint heartbeat)	This is the instrument picking up the noise of its own internal meter circuitry and not external microwave signals. This will only happen if the external field levels are well below 0.02 V/m.. The displays will not show that any signals are present.
The peak signal is high, but the average signal is low.	This is normal and to be expected from modern digital microwave frequency signals.
The instrument is on, but the LCD screen is blank or shows a row of black squares	The instrument is stuck because it was turned off then on too quickly. Make sure that you leave 1 second between turning it off and turning it on again.
The instrument makes three loud beeps from time to time	This is an indication that the batteries need replacing. Check for a "Low battery" screen message next the time it beeps.

Guarantee

The Acoustimeter comes with a 2 year return-to-base Manufacturer's Guarantee. Please contact us (see page 12) for details and to arrange a return if required. It is guaranteed to be free of manufacturing defects, but not against wear from normal use, nor damage caused by water or by physical impacts such as from dropping it. It has a degree of overload protection built-in, but it should not be used next to high-powered RF transmitters that are likely to grossly overload it. Approach these with caution and watch the displays to avoid gross overload.

Appendix A : a comparison of some international guidance levels

General Public Levels	Frequency MHz	E field V/m	Power W/m²	Power μW/m²
ICNIRP, 1998 (recognised by WHO, EU & UK) **CENELEC, 1995**	400 900 1800 2100	28 41 58 61	2 4.5 9 10	2 000 000 4 500 000 9 000 000 10000000
Russia 2003 (general public), PRChina	300 - 300000	6	0.1	100 000
Italy, Decree 381 (1999)	30 - 30000	6	0.1	100 000
Swiss Ordinance ORNI (*for base stations)* From 1st. Feb. 2000 (rms values)	900 1800	4 6	not specified	not specified
EU & UK EMC Regulations suscept test level (domestic & comm.)	30 - 2000	3 any signal	not specified	not specified
Belgium - Wallonia	900, 1800, 2100	3	0.024	24 000
Typical max in public areas near base station masts (can be higher)	900 & 1800	2	0.01	10 000
USA City Dweller max (FCC 1999)	Aprx. 30 - 300000	< 2	< 0.01	< 10 000
Wien (Vienna)	Sum of GSM	1.9	0.01	10 000
Italy (2003) each base station (aim); Lichtenstein law from 2013	900, 1800, 2100	0.6	0.001	1000
Salzburg - 1998 & 2000	Sum of GSM	0.6	0.001	1000
BioInitiative, 2007	30 - 300000	0.6	0.001	1000
EU-Parliament, GD Wissenschaft, STOA GSM (2001)	900, 1800, 2100	0.2	0.0001	100
Typical US (EPA 1980, mainly FM & TV)	Aprx. 30 - 300000	< 0.13	< 0.00005	< 50
Salzburg - 2002, outside houses aim	GSM UMTS 3G	0.06	0.000 01	10
Salzburg - 2002, inside houses	GSM UMTS 3G	0.02	0.000 001	1
Bürgerforum - BRD 1999	GSM UMTS 3G	0.02	0.000 001	1
Mobile phone handsets will work at these levels	900, 1800, 2100	0.00001	< 0.000 000 000 1	< 0.000 03
Broadband 'natural' background	300 - 3000	< 0.00003	< 1 e-13	<0.0000001

Appendix B

Conversion between V/m and µW/m^2 for *continuous wave* (CW) signals

There is an approximate equivalence between the columns of LEDs for CW signals. It is not possible to calculate the average power in a digitally modulated communication signal without detailed analysis of the signal waveform. This is what the Acoustimeter does for you and it presents the result on the average power LED display.

For accurate conversion of CW signals use the formulae:

Power Flux Density in W/m^2 = (V/m)*(V/m) / 377

Electric Field Strength V/m = square root ([W/m^2] * 377)

1 W/m^2 = 1,000,000 µW/m^2 = 100 µW/cm^2 = 0.1 mW/cm^2

or use the EMFields website calculator

http://www.emfields.org/detectors/acoustimeter.asp

A digital, pulsed, signal will often have a signal strength in volts per metre (V/m) significantly higher than the listed equivalent CW average power (µW/m^2). This is due to the waveform of the signal.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive requires that old and unwanted electronic equipment must be disposed of using appropriate recycling and not placed with your normal domestic waste. When you no longer require your Acoustimeter, you can return it to us for recycling. Your postage will be refunded. Most UK local waste recycling centres also provide free collection points for WEEE.

Disclaimer

While EMFields considers that the information and opinions given here are sound, you must rely upon your own skill and judgement when interpreting or making use of the information contained in this manual.

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